Using Accelerometers and GPS in Active Living Research:

Practical Issues

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NIH Studies

Study	Aims	PI	Population	N	Mode of delivery	Device use
NQLS 2001-2007	Walkability & PA	Jim Sallis	Adults, 20-65	2000	Mail	Accelerometer (Actigraph 7164, 71256)
NQLS-S 2004-2009	Walkability & PA, Physical Functioning	Abby King	Seniors, 66+	900	Mail	Accelerometer (Actigraph 7164, 71256)
NIK 2005-2010	Walkability/ Rec/Food Environment & BMI, PA, Diet	Brian Saelens	Children, 5-11	800	In-person & mail	Accelerometer (Actigraph GT1M)
TEAN 2007-2011	Walkability, Rec/Food Env & PA, Diet	Jim Sallis	Teens, 12-16	850	Mail	Accelerometer (Actigraph 7164, 71256) & GPS (GlobalSat DG-100)
IPEN 2009-2013	Walkability & PA in numerous countries	Jim Sallis	Adults, 18-65	3000	In-person & mail	Accelerometer (Actigraph 7164, 71256)

Format of workshop

- **Presentation**
  - A. Actigraph Equipment & Tracking
  - B. Compliance for Wear Time
  - C. Actigraph Data Screening & MeterPlus
  - D. GPS Data Collection

- **Breakout sessions**

  Goals:

  1. ask more in-depth questions

  2. learn from others experience & approaches

  3. get hands-on with the equipment, data, software, etc.

Learning Objectives

A.   Actigraph Equipment & Tracking

1.   What pieces are needed to get started

2.   How to intialize Actigraphs

3.   How to download data

4.   Benefits of having good tracking database

B.   Compliance for Wear Time

1.   Tips for describing to participant

2.   Tips for in-person & mail delivery & retrieval

3.   Tips to increase compliance

4.   Prompting protocols

Learning Objectives

C. Actigraph Data Screening & MeterPlus

1.   Why it's important to screen data

2.   What 'valid' vs 'invalid' data look like

3.   Features/benefits of using MeterPlus

D. GPS Data Collection

1.   What pieces are needed to get started

2.   How to initialize the DG-100

3.   How to download data

4.   What descriptions & instructions are helpful

     for teens

Quality Control & Data Management

- Important to devote time & effort to quality control & data management
- An investment to get better measurements
- One devoted staff person, half-time job

Actigraphs: Equipment & Tracking

Erin Merz

7164

GT1M

Equipment

- Actigraphs
  - Label with contact info & serial number
  - Label to show participants which side goes up
  - Inventory in a database
  - Price about $300 each
  - Not waterproof
  - Data collection speed controlled by # devices
    - Ongoing: 1 for every 10 participants to measure in a year

- Belts, clips
  - Where to purchase material
    - Information in handout
  - Different size belts
  - Loss rate higher for clips
  - Worn under or over clothing

- Calibrator for older models

Initializing

■ Actilife software
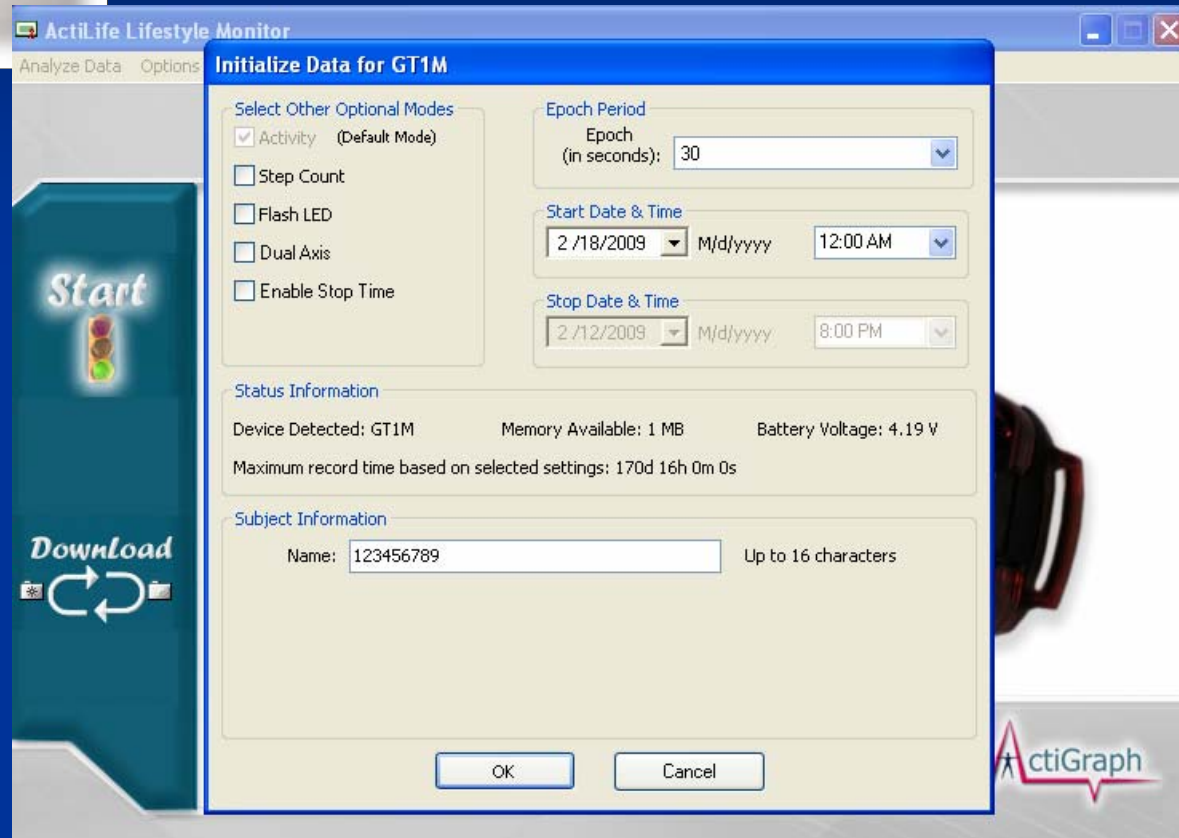
- 2 week battery life so initialize when participant is ready to wear

- Standardize start time to make processing easier – 12am is ideal

Initializing
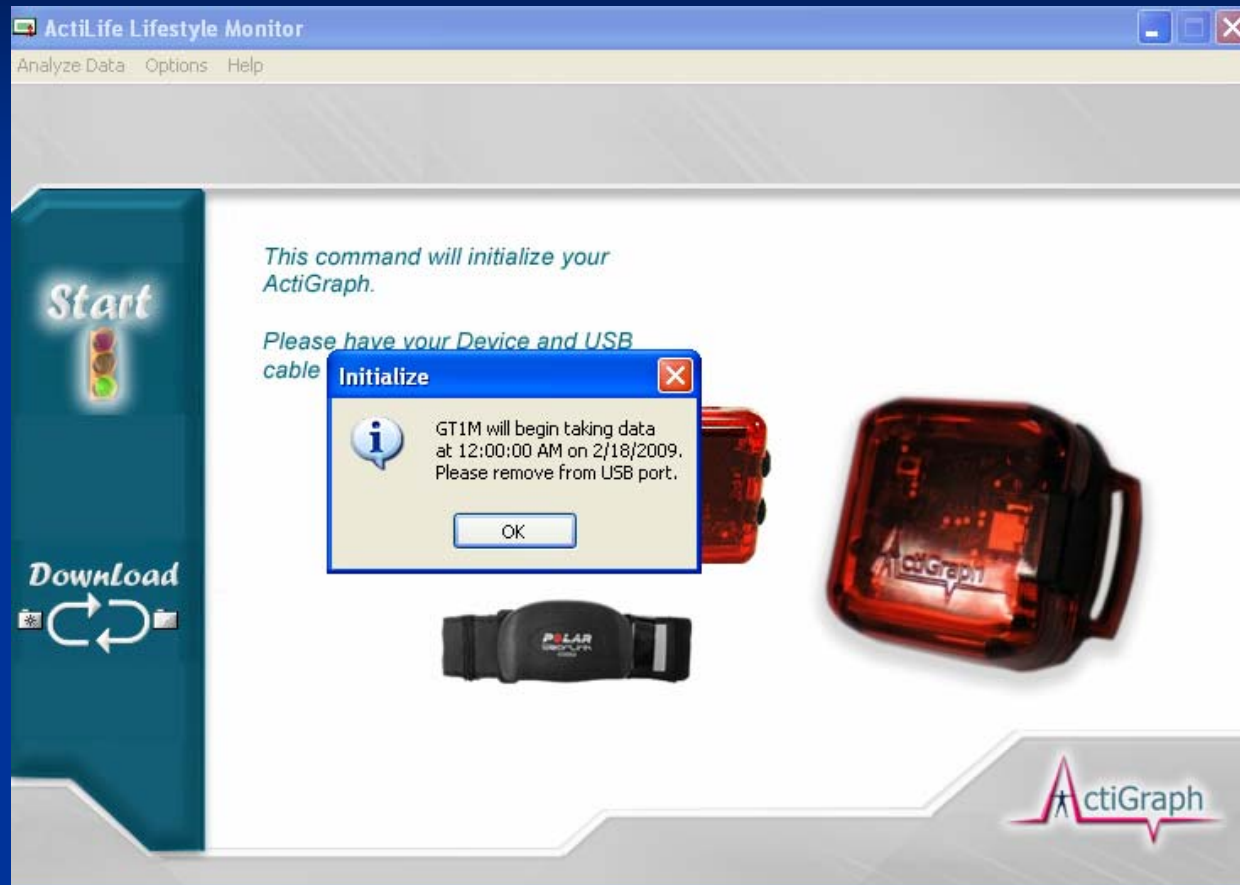
- Flashing light in "1" sequence is delay mode before actively collecting data. Once collecting data, will not flash.

Downloading

- Save data as .dat file

- File naming

- Errors
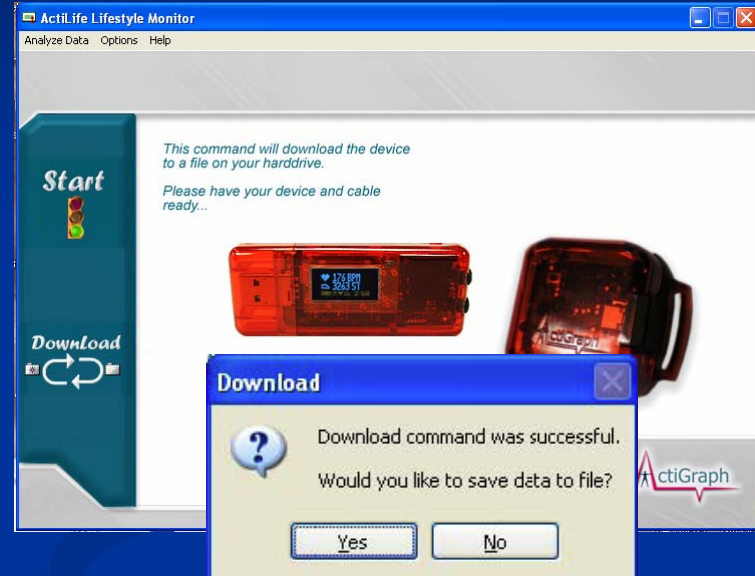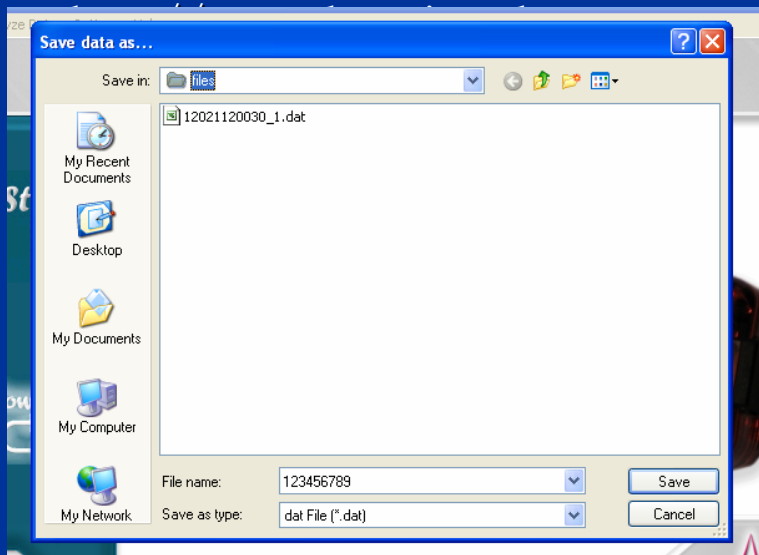
Mailing

- Online USPS (click-n-ship)

- Priority Mail (http://www.usps.com/shipping/prioritymail.htm)

- Tracking both ways with email confirmation

- Costs:
  - Postage: $4.80 each way
  - Padded envelope: $.70 each
  - Flat Rate envelope: free
  - Labels: $.20
  - Budget for increasing postage rates
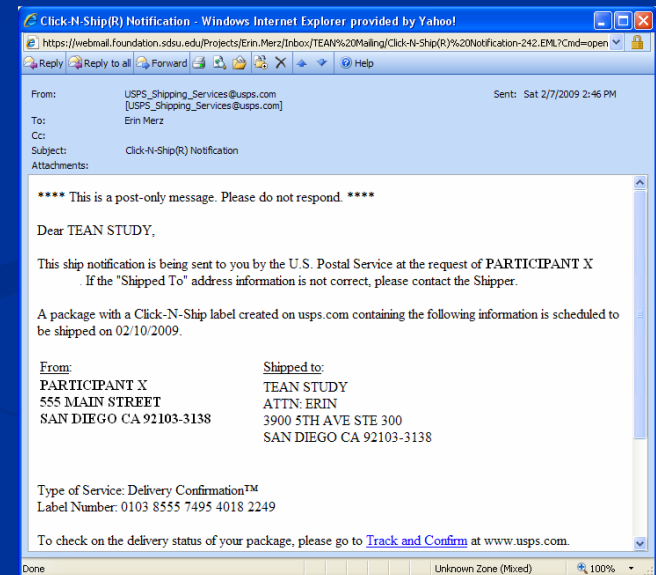
Tracking

- Access database

- Each wearing is a record

- Track by serial number and participant

- Queries
  - Length of time out
  - Problem units
  - Compliance rates
  - Outstanding units

Access Database

Compliance for Wear Time

Carrie Franklin

Rates

Study	Valid Wearing Time Guidelines	Compliance Always ask for 7 days	Return Time (median)	Equipment Loss Rate
Seniors	5 valid days, <45 minutes of consecutive "0" counts per hour	90%	20 days	0.7%
Adults	5 valid days, <30 minutes	88%	20 days	2.6%
Teens	5 valid days (1 weekend), <30 minutes	76%	23 days	2.4%
Children	6 valid days (1 weekend), <20 minutes	74%	21 days	1.6%

- Valid day = 10 valid hours
- We always ask for 7 days. Most people wear it the suggested number of days, just not for enough time per day

Description for participant

- Like pedometer
- Runs on battery
- Measures movement, not what you're doing or where you are
- Recruiter's personal experience
- Project website
- Incentives
  - $10 per measure (e.g., meter and survey = $20)

In person delivery & retrieval

- Include parent & child

- Show how to wear and talk about when to wear

- Special privilege

- Valuable

- Stress how long to wear (see charts)

- Will ask to re-wear

- Provide envelope for return

- Home pick-up
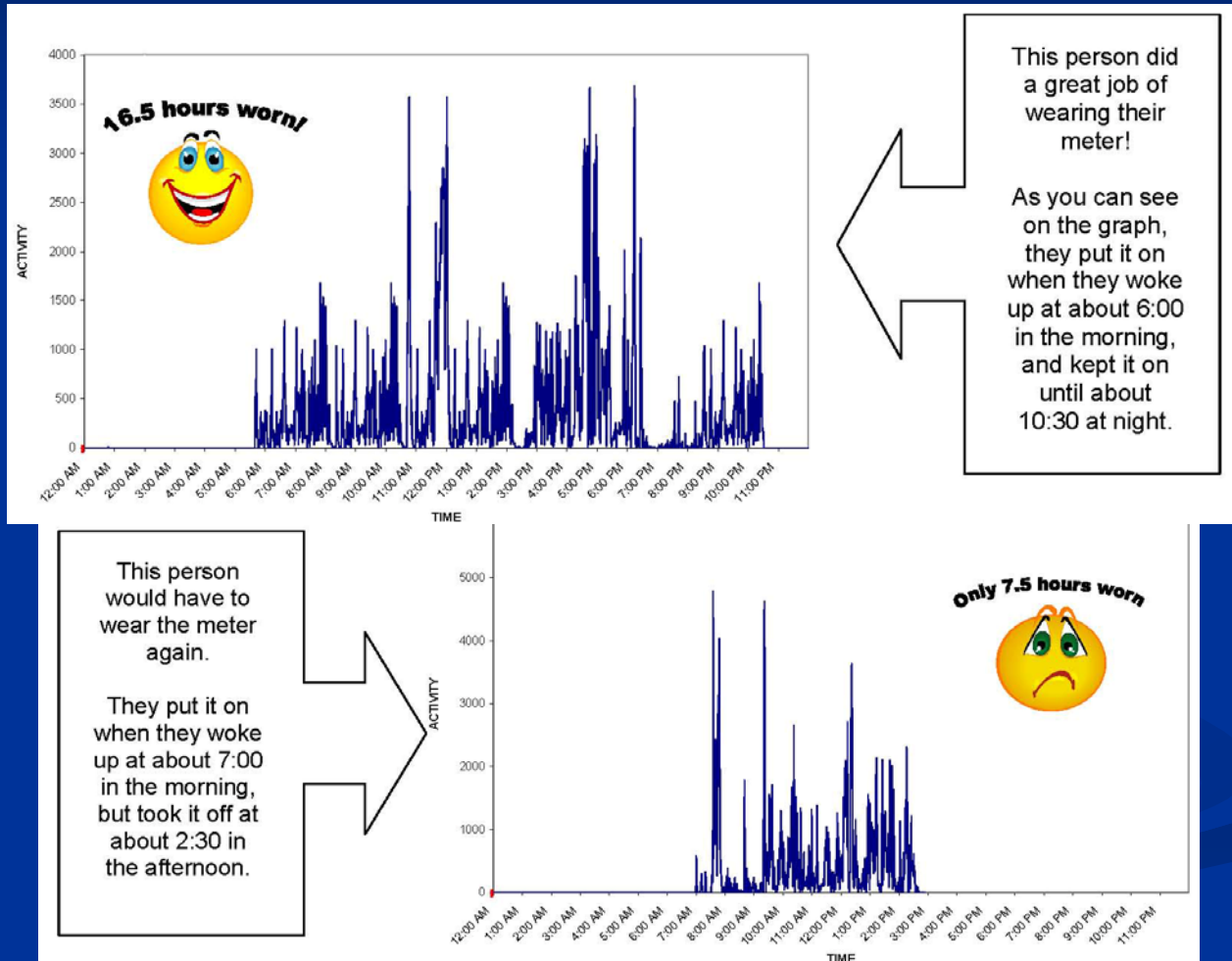
Mail Delivery & Retrieval

- How to wear meter

- Increase valid wearing time expectations (i.e., ask for 12 hours)

- Providing an end date improved return time by 3 days

- Toll-free number and email address

How to Wear the Activity Meter

This small activity meter records general movement and allows us to get a better idea of your overall activity level. We will **not** be able to tell what kind of specific activity is happening. At first, the belt may feel slightly awkward, but after a few hours, you will probably get used to it and not notice it as much. It is **extremely** important for our study that you wear the meter properly. If it is not worn properly, we may have to send it back for you to wear again. Please follow these instructions carefully:

- Wear the meter attached to the belt around your waist, just above your <u>right</u> hipbone. You can wear it either underneath or on top of your clothing.
- Wear the meter so that the star sticker is facing **up**.

- Wear the meter **snug** against your body. If you have to, you can adjust the belt by pulling the end of the strap to make it tighter. Or, to loosen the belt, push more of the strap through the loop. **Wear the belt tight enough so that the meter does not move when you are being active.**
- Please **put it on first thing in the morning** -- either just after you get out of bed or just after you shower or take a bath in the morning.
- **Do not submerge the meter in water** (swimming, bathing, etc.)
- Keep the activity meter on all day (unless swimming or in the water).
- At night, **take it off right before you go to bed. You should be wearing the meter for *at least* 12 hours each day.**
- Do not let anyone else wear it.

- **The meter has a very short battery life.**
- **The last full day that it will work is _____. If you cannot begin wearing it by _____, please call 1-877-440-4832 as soon as possible!**

There is <u>no</u> "ON" or "OFF" switch that you need to worry about turning on or off every day. The activity meter runs on a battery and is programmed to run continuously without you needing to turn it on. Please do not try to open the activity meter.

Log/Journal

Meter Log

Wear the movement meter for seven (7) consecutive days.* In the table below, write down the dates and days on which you wear the meter. Note the times, including "a.m." or "p.m." that you put it on and take it off during each day. Below is a sample entry:

Date	Feb. 23, 2005	
Day	Wednesday	
On		**Off**
7:30 a.m.		11:00 a.m.
11:15 a.m.		10:45 p.m.

We have included extra spaces/rows in case you need to take the meter off during the course of the day. If you take the meter off for <u>more than 5 minutes</u>, such as showering, record when you take it off and put it back on.

Date														
Day														
	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off

*If you are unable to wear the meter for seven (7) consecutive days, add additional days at the end of the week.

FOR OFFICE USE ONLY

Participant ID_____ Recruiter _____

Serial Number_____
Date Initialized_____
Valid days _____

Prompting Material Return

Phone calls

- First calls: to remind of criteria, proper wearing

- Prompt calls weekly

Emails

- Use in combination with phone calls, most effective with adults and teens

Mailings

- Last resort: if phone calls are not successful, begin mailing return materials, reward letter

Materials

- Stickers for young kids
- Instruction sheets
- Logs/Journals
- Charts
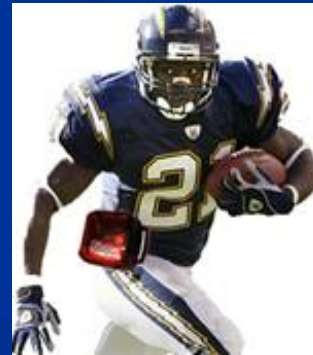
Questions?

Actigraph Data Screening & MeterPlus

Kelli Cain

Data screening

- Screen data right away
  - Re-wears
  - Compliance only 75% in children & teens. Would lose opportunity for good data in 25% without screening protocol in place
- Looking for valid wear time & device malfunction
- Custom software (MeterPlus) makes this easy

Examples of data

- Wear time

- Mail days

- Malfunction/Invalid data

Wear time – typical pattern

Mail days

Malfunction – invalid data

Constant, repeating, often "32767"

Counts >16,000, don't have to fill the entire day.

Constant, repeating

MeterPlus

Version 4.0

MeterPlus

SANTECH, INC.

- User-friendly & flexible
- Anyone can use it
- Program settings appropriate for your study
- Will <u>batch-process</u> your files

The birth of MeterPlus

Before

After

Visual screen for consecutive zeros

Automated screen for consecutive zeros

Copy & paste data for each file

Batch score

Steps

Screen

Screen .dat files for enough valid wear time.

Clean

Eliminate non-wearing time by creating .mpd files from .dat files.

Score
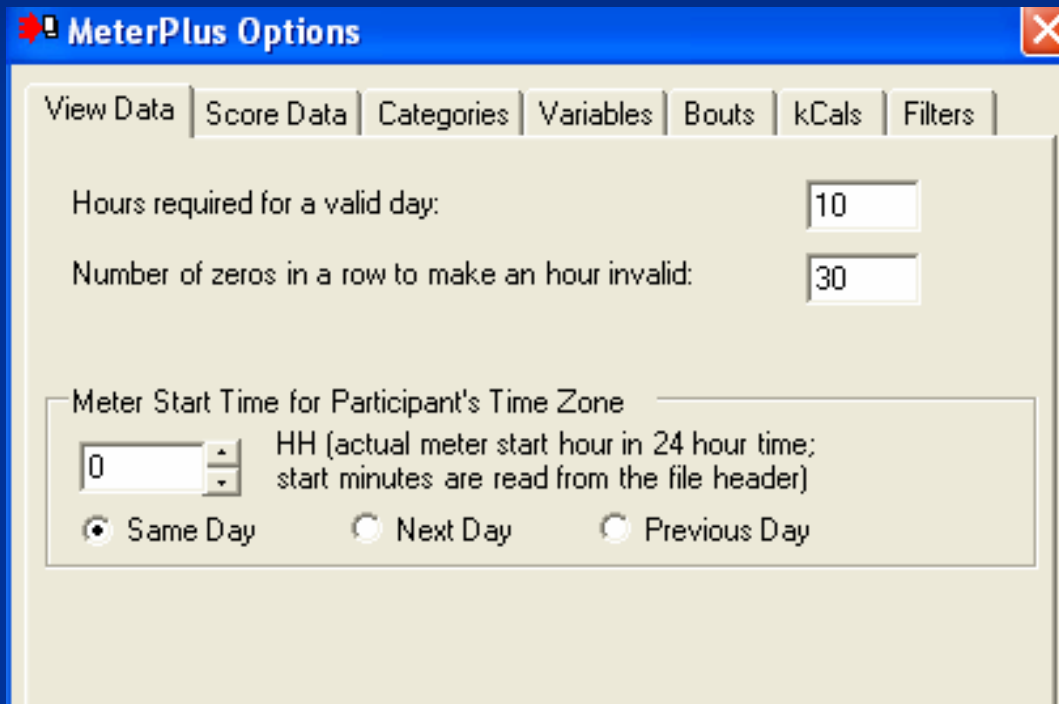
Score .mpd files to create a comma-delimited file containing activity intensity, bouts, energy expenditure & time-filtered activity variables. Can be done in a batch.

Analyze

Import the comma delimited file into statistical software and analyze.

Settings for screening

Screening files

List View

Detailed View

Red flags

Malfunction

Step count
mode enabled

Battery separation problem –
repeat data

Settings for cleaning data

Saving wear time to .mpd file

Cut-points

Create Groups

Add/Edit Cut-points

Filename

Bouts

Energy expenditure

Time filters

Scoring

Age & weight

Sample age file

Batch score

Output

- .mtf = time filter variables in comma-delimited file

- .sco = activity, bouts & kcals in comma-delimited file

- .sps = SPSS import syntax

- .sav = SPSS file
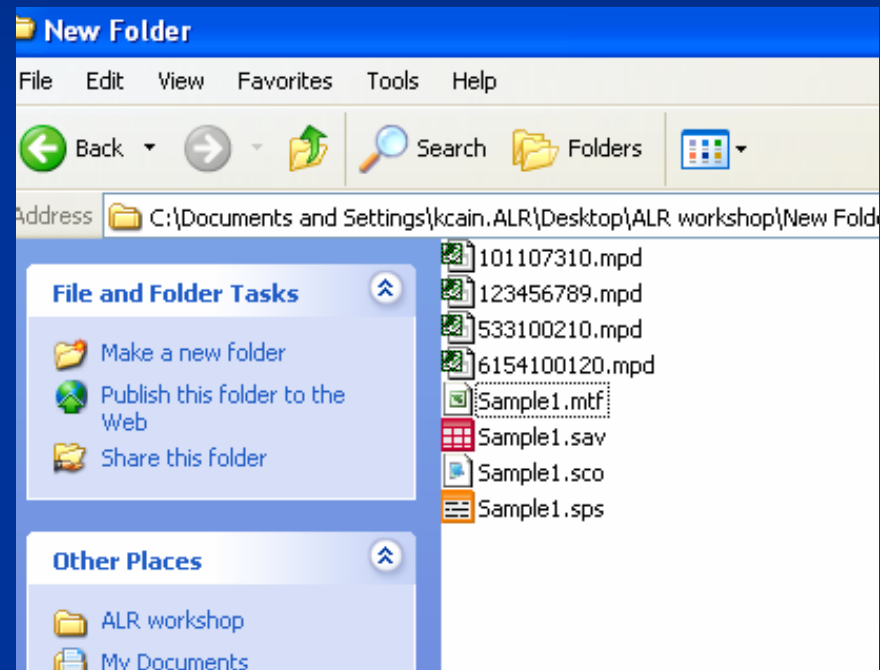
Time Filter variables

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	Filename	1Day	1Date	D1T1_st_t	D1T1_end	D1T1_epo	D1T1_not	D1T1_sed	D1T1_ligh	D1T1_mo	D1T1_har	D1T1_very	D1T2_st_t	D1T2_end	D1T2_epo	D
2	101107310	Wednesd:	11-12-200	07:00 AM	11:00 PM	960	301	609	45	6	NULL	NULL	NULL	NULL	NULL	N
3	53310021C	Thursday	11-24-200	07:00 AM	11:00 PM	960	120	722	118	1	NULL	NULL	NULL	NULL	NULL	N
4	615410012	Tuesday	01-22-200	07:00 AM	11:00 PM	960	361	427	167	6	NULL	NULL	NULL	NULL	NULL	N
5																
6																
7																

Activity counts falling within each activity category during each time period defined in the settings, for each day of data.

E.g., *D1T1_moderate* = 6 epochs of moderate activity occurring during 7am & 11pm on day 1

Activity, Bouts, EE variables

Activity

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	SN	city	neighbo	walka	group	id	Filename	Date	TotDays	VldDays	VldHours	TotVdnot_wearin	TotVdsedent	TotVdlligh	TotVdmod	To
2	50168	1	1	1	0	7310	101107310.DAT	11/12/2003	8	8	102	5434	3585	2404	93	
3	51165	5	33	1	0	0210	533100210.dat	11/24/2005	8	8	97	5915	4510	1087	8	
4	50293	6	15	4	0	0120	6154100120.dat	1/22/2008	7	7	89	4808	3438	1720	114	
5																

Serial number, start date, # valid days & hours, number of epochs in each activity category across all valid days.

Bouts

	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ
1	D1_bout_num	D1_bout_length	D1_bout_avg	D1B1_st_time	D1B1_end_time	D1B2_st_time	D1B2_end_time	D1B3_st_time	D1B3_end_time	D1B4_st_time
2	1	14	14	11/12/2003 13:47	11/12/2003 14:01	NULL	NULL	NULL	NULL	NULL
3	1	10	10	11/24/2005 9:00	11/24/2005 9:10	NULL	NULL	NULL	NULL	NULL
4	4	119	29.75	1/22/2008 0:00	1/22/2008 0:17	1/22/2008 6:59	1/22/2008 8:07	1/22/2008 8:32	1/22/2008 8:55	1/22/2008 9:53
5										
6										

Number of bouts, total and average length of bouts, start and end times of each bout.

Energy Expenditure

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT
1	Tot_kcal	KCal_mean	KCal_peak	KCal_not_w	KCal_sedentary	KCal_light	KCal_moderate	KCal_hard	KCal_very_hard	D1Date	D1Day	D1vday	D1vh
2	1195.47	149.43	224.58	0	49.81	1145.66	0	0	0	11/12/2003	Wednesday	1	5
3	463.31	57.91	95.95	0	31.55	431.76	0	0	0	11/24/2005	Thursday	1	1
4	863.27	123.32	167.77	0	33.68	829.59	0	0	0	1/22/2008	Tuesday	1	8
5													

Total, mean & peak caloric expenditure, caloric expenditure in each activity category.

MeterPlus

- Where to get more information

  www.meterplussoftware.com

- Demonstration at breakout session

- Brochures & sign-up sheets for more information

Questions?

GPS Data Collection

Jill Dumbauld

Why using GPS

- Replaced travel diary
  - Save staff time to process
  - More accurate than recall

- Routes taken

- Commuting

- Merge with accelerometer data

GlobalSat® DG-100 Data logger

- Little user interface (disable slide switch)
- Long battery life (about 20 hours)
- Good Sensitivity
- Windows utility
- Economical ($65)

- More Bulky
- Slower charge

Recruitment Strategies

- Not real-time data
- Convenient, can carry
- Positive feedback from past participants

- Use of maps as incentives

Preparing Units for Use

- Stickers and Labels

- Send "connected"

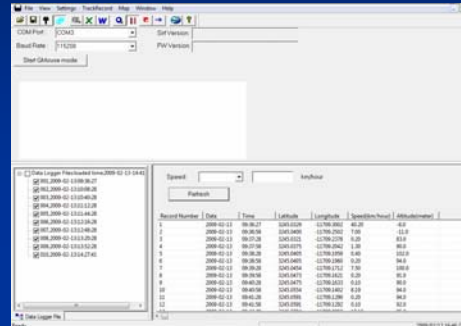# Configuring the Units

- Delete previous data

- Configure

Downloading Data

- **Download**

- **Save / export to 4 formats**

- **Double-check configuration**

GSD

CSV

KML
(Google Earth)

TXT

Troubleshooting the GPS - Issues

- **User Issues**
  - Battery Charge
  - Power Button
  - Forgetting Unit
  - Frequent questions

- **Device Issues**
  - Freezing
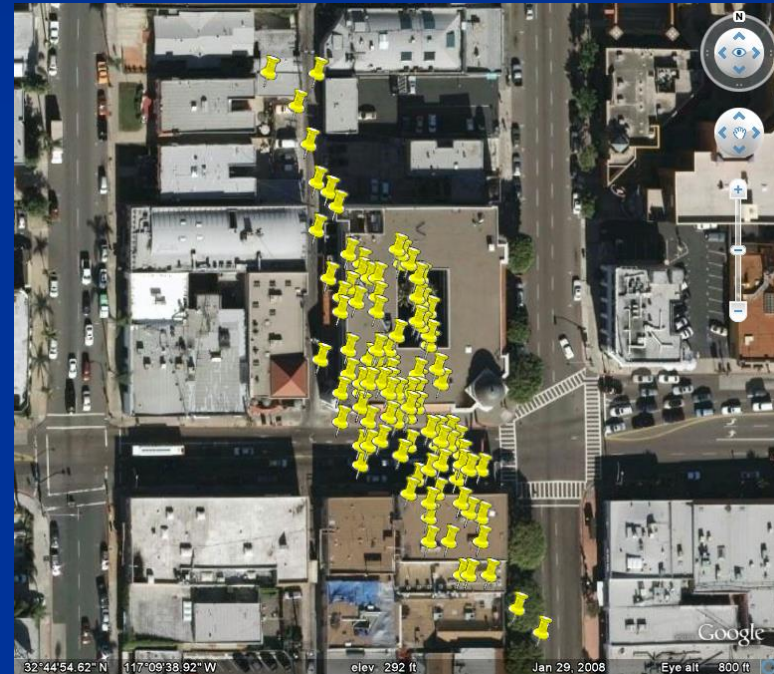
Functional unit in place for 1 hour

Troubleshooting the GPS - Strategies

- **User Issues**
  - Detailed instructions
  - Research Assistant follow-up
  - Meter / GPS Log

- **Device Issues**
  - Rebooting by pulling out batteries

Information about the GPS Unit

How does the unit work?
GPS stands for Global Positioning System. This system uses satellites in space to find and record locations on Earth. Every 30 seconds, it records and stores the time, date and location in its memory. It does not transmit this information to us – we will only see where you have been once we get it back.
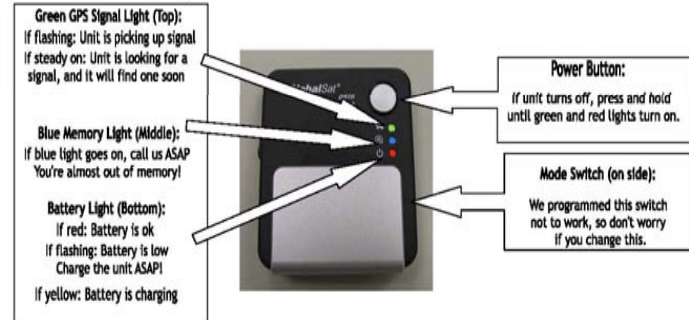
Why do I have to set it up on the first day?
When the unit travels a long distance (like from our California office to your home), it takes a bit of time to readjust to its new location. It is important to keep it still at your home for a while so it can "find" the right satellite signals.

How can I tell if it's working? What if I notice that the lights are off?
If the green light is flashing, then it is working just fine. If you find that the green light stays solid for a long time, even though the red light is on, please call us! It needs to be reset. If you find that the lights are off, just hold the power button until the red and green lights turn on.

What do the buttons, lights and switches mean?

Green GPS Signal Light (Top):
If flashing: Unit is picking up signal
If steady on: Unit is looking for a signal, and it will find one soon

Blue Memory Light (Middle):
If blue light goes on, call us ASAP
You're almost out of memory!

Battery Light (Bottom):
If red: Battery is ok
If flashing: Battery is low
Charge the unit ASAP!
If yellow: Battery is charging

Power Button:
If unit turns off, press and hold until green and red lights turn on.

Mode Switch (on side):
We programmed this switch not to work, so don't worry if you change this.

What if the battery dies? Will it erase everything?
If the battery dies, the unit will not erase the data that it has already collected. It just won't be able to collect new data. So, make sure you keep it well-charged by putting it on the charger every night before you go to bed.

How do I recharge it?
Just plug the unit into its charger, and plug the charger into an outlet. Don't forget to keep the unit *on* while charging!

What if I have more questions?
Call or email us at 1-877-440-4-TEAN, or teanstudy@projects.sdsu.edu. Please leave a message if you reach the voice mail, and someone will return your call.

Questionnaire

- **What motivates you?**
  - Incentives most common

- **Wearing vs. carrying GPS**
  - Most prefer to carry

- **Tips for other participants**
  - Keep with cell phone, iPod to help remember

Questions?

Break-out sessions

Station A: Actigraph Equipment & Tracking,
                    Erin Merz

Station B: Compliance for Wear Time,
                    Carrie Franklin

Station C: Actigraph Data Screening & MeterPlus,
                    Kelli Cain

Station D: GPS Data Collection,
                    Jill Dumbauld